# INVESTIGATING THE CAUSE(S) OF THE *EUCALYPTUS GOMPHOCEPHALA* (TUART) DECLINE EPIDEMIC IN WESTERN AUSTRALIAN NATIVE FOREST

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## INTRODUCTION

Tuart is a magnificent woodland tree endemic to the Swan Coastal Plain of Western Australia, and is one of the few eucalypts that is adapted to calcareous soil profiles (1). Prior to European settlement there were more than 111,600 ha of tuart woodlands (2) but this has been reduced to 30,311 mostly as a result of clearing for urban development and agriculture (3). In the early 1990's the decline of tuart woodlands in Yalgorup National Park (YNP), 1.5 hours south of Perth, became severe causing public awareness and concern. At present, the majority of the 13,000 hectares of this park is affected. A large research group was established in 2003 to investigate the cause(s) of this decline, conducting research on a range of abiotic and biotic factors, including water relations and hydrology, environmental correlates, fire and competition, mycorrhizae and nutrition, fungal pathogens and insect pests. The collaborative, integrated and adaptive approach to the research, and the latest findings of the group will be presented.

## MATERIALS AND METHODS

A wide array of methods have been adopted in this research, ranging from vegetation surveys, canopy assessments, GIS, controlled burns, ashbed trials, and root excavations, to pressure bombing, foliar analyses, inoculation trials and fungal isolations. Fungi have been isolated from leaves, stems and roots of trees, using traditional techniques, and more innovative techniques. For comparison of roots systems between trees with healthy and declining canopies and to accurately locate necrotic roots, we have used the air-spade, which is a tool that penetrates and dislodges soil around the root system by producing a stream of supersonic air moving at mach 2. We have successfully used this system to identify necrotic roots and isolate pythiaceous fungi from these.

## RESULTS

Some of the current findings of the research are as follows:

- Fine feeder root necrosis is associated with declining trees, and a *Phytophthora* sp. and *Pythium* spp. are recovered frequently,
- There are fewer mycorrhizal pads associated with declining trees than healthy trees and this observation is closely associated with the above point,
- Trees growing within YNP with symptoms of severe decline have different foliar nutrient profiles than trees growing outside the national park that are in good health,
- Seedlings and saplings are infected with a range of pathogens, including *Mycosphaerella cryptica*, which appears to have a significant impact on their survival and growth,
- Seedlings exhibit greater rates of survival and growth on ashbeds compared to off ashbeds,
- Tuart uses a combination of capillary fringe and shallow soil water, with no apparent water source partitioning occurring between size classes,
- Seedlings are more susceptible to loss of xylem function with the onset of water stress than saplings or mature trees, however, critical water potentials for loss of xylem function have been rarely breached in any size class or location over the 14 months,
- GIS mapping has shown that the decline is spreading rapidly through YNP and has been occurring since 1991,
- Compared to other tuart regions, YNP shows a high correlation with higher rainfall, finer and shallower soils, higher groundwater alkalinity and salinity, and greater rates of groundwater salinity increase,
- A conceptual model of tuart canopy decline with hypothesized processes of regional scale canopy decline, and severe canopy decline in the Yalgorup region has been developed.

## DISCUSSION

Overall, this work has shown that YNP is the epicentre of the decline, and the decline is extending rapidly from this point. Using a multi-disciplined approach, we have shown that the decline syndrome is complex and a range of biotic and abiotic factors may be involved, enabling us to focus more intently on specific areas of research to determine the cause(s) and provide management solutions.

## REFERENCES

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